

Chapter 4

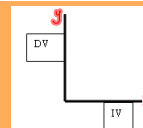
Modeling Functional Relationships

Section 4.1

Tables, Graphs and Connections

REVIEW

Dependent and Independent Variables



(Y) Dependent -- a variable in an expression whose value depends on the independent variable.

(X) Independent -- A variable that is not affected by any other variables with which it is compared.

DEPENDENT Marks depend on how much time you spend studying INDEPENDENT
DEPENDENT Number of plants in a garden depends on the length of your garden INDEPENDENT

For Example:

Some students collected data comparing the amount of time spent at a video arcade with the amount of money spent. Their data are shown in the table:

Amount (\$)	1.25	1.75	2.00	2.50	3.00	3.25	3.50	4.00
Time (min)	45	60	60	100	140	130	140	140

Dependent Variable -- The one that is affected by other factors in a relationship - Amount \$

The amount of money you spend depends on how much time you spend in the arcade.

Independent Variable -- The one that affects the other factors in a relationship - Time

Amount of money affects how much time you get to stay in the arcade.

The amount of money is what matters...if you run out of money you can't spend any more time in the arcade.

Pg. 157

FOCUS A

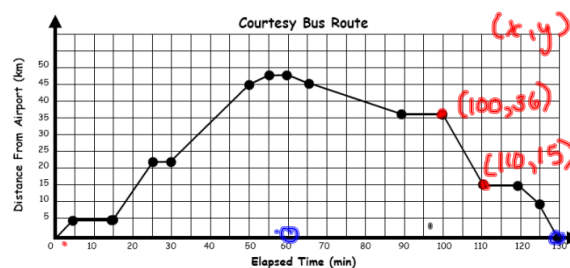
Creating a Broken-Line Graph

Pg. 157

Broken-Line Graphs

A **broken-line graph** is a graph which is formed by joining data points with line segments. Broken-line graphs tell a story.

Allan landed at Halifax International Airport and took the hotel courtesy bus to his hotel. The graph below shows the distance of the bus from the airport over time. It also shows that the speed of the bus varied as it traveled along its route. These data are shown with a **broken-line graph**.



- What do the points represent?
- Describe the resulting appearance of the graph.
- • What does the highest point on the graph represent?

Calculating the fastest speed on the graph (pg.157).

-look for the steepest slope.....line segment 100 min to 110 min

-find the slope: need two points:

$$\begin{aligned}
 & \begin{matrix} (100, 36) & (110, 15) \\ x_1 & y_1 & x_2 & y_2 \end{matrix} & m = \frac{y_2 - y_1}{x_2 - x_1} \frac{\text{km}}{\text{min}} \\
 & m = \frac{15 - 36}{110 - 100} = \frac{-21}{10} = -2.1 \\
 & \text{The speed is } -2.1 \text{ km/min}
 \end{aligned}$$

1) You can find the slope of the line between any two times on the graph of the bus trip.

a) What does the slope represent?

b) How can you use the slope to describe the movement of the bus?

2) If you look at the first half of the courtesy-bus graph, most of the slopes are positive. The slopes for the second half are mostly negative. What does this tell you about the trip?

Chapter 4 - Tables, Graphs and Connections

"A picture is worth a thousand words." **Graphs are a picture of data.**

In this chapter you will investigate how to create and interpret the "story" graphs are telling.

- Speed represents the change of distance over time
- Velocity is speed with a direction
- A negative velocity indicates a movement in the opposite direction.

Slope = Speed (m = "rate" of speed)

Walking Slowly (Least steep)

Walking Normally

Walking Quickly (Steepest)

Stops $m = 0$

Positive Slopes have lines that are in an upward direction

Negative Slopes have lines that are in a downward direction

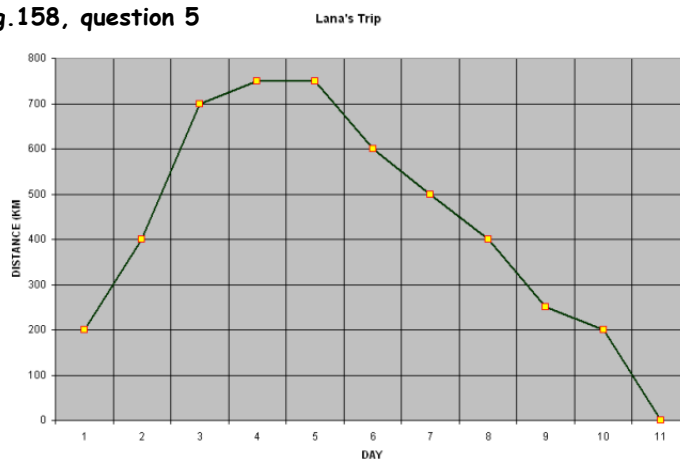
Pg. 158
#5, 6
↑
graph

Classwork/Homework

Pg.158 #5 and 6

(Use graph paper for #5 and don't forget to label each axis)

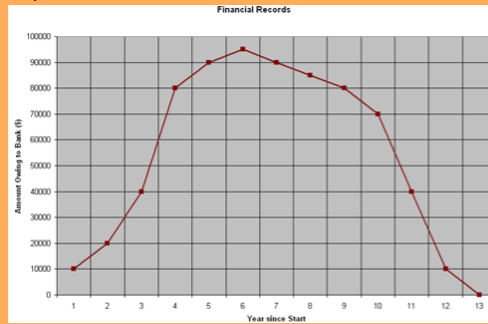
Pg. 158, question 5



b) Possible Answer:

- During the first day Lana traveled 200km.
- She continued traveling for the next few days until, on day 3, she was 700km from home.
- During days 4 and 5, she traveled more slowly, as evidenced by the smaller slope on the graph.
- At the end of day 5, she was at her maximum distance from home.
- The negative slope between day 5 and day 6 means that Lana was returning home.
- During days 6 to 8, she moved back toward home slowly.
- On day 9, the large negative slope indicates that she was quickly heading home.
- She arrived home on day 11.

Pg.158, question 6



a) (i) The maximum point on the graph represents the maximum amount that Jake owed.

(ii) The slopes of the line segments indicate the "rate" at which he is borrowing.

-Large positive slopes indicate that in that period of time, he is borrowing a large sum of money.

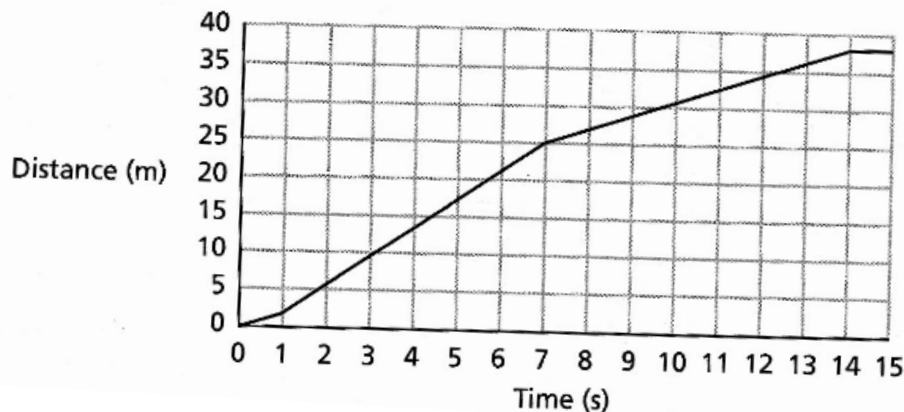
→ (iii) A negative slope indicates that the amount that he owes is decreasing. In other words, negative slopes indicate that he is actually paying off his line of credit.

b)

- In each of the first 3 years of operation he borrowed increasingly greater sums of money.
- This trend slowed in year 4 (the maximum)
- After this time, the negative slopes indicate that he began paying back the loan.
- He made the greatest payments between 9 and 11 years.
- The loan was actually paid off in year 12.

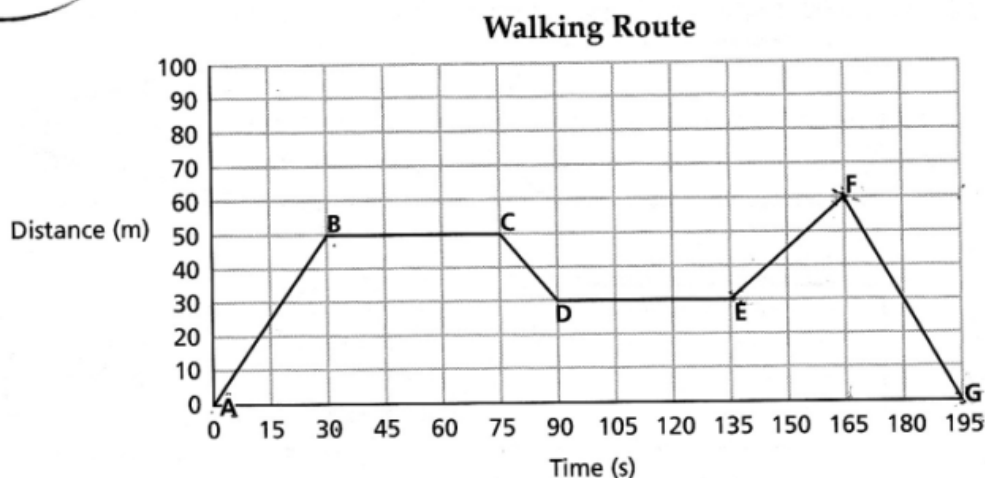
Practice Question #1

The graph below shows the distance versus time for a runner in a short race. Use your knowledge about slopes to write a description of the race for this runner.



Practice Question #2

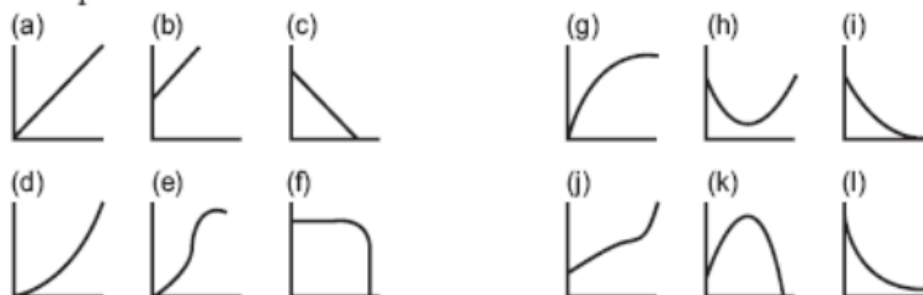
1. Jacinta ran to buy a newspaper from the corner store. The graph below shows her distance from home at various times.



- What was her fastest speed? How long did she run at this speed?
- For how long was she stopped? How can you tell from the graph?

- ☐ From the 12 graphs that follow, choose the graph that best describes each of the following situations and explain your choices.
- John's performance maintaining his pace running up hill
 - the amount of daylight, depending upon the time of the year
 - the cost of a taxi cab trip is \$2.00 plus \$1.00 per minute
 - the path of a golf ball
 - ~~the amount of dough needed to make pizza crusts is calculated from knowing the diameter~~
 - a runner's strategy of starting quickly, slowing to an even pace and then sprinting toward the finish
 - the number of cigarettes smoked affecting your breathing in a negative way

For the graphs that remain, describe situations that could produce graphs of those shapes.



"Matching Worksheet"

- Try your best to match a graph with each situation. You can use the same graph for more than one situation, if necessary.
- Be prepared to explain your choice.

①. G, H, f

②. J

③. L

K, ~~E~~, ~~I~~

④. K

⑤. A

⑥. B

⑦. C

Classwork/Homework

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#8, 10, 12

Answers Pg.160-162 #8,10

#8

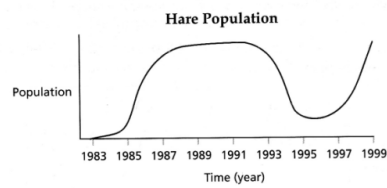
- a) The lowest points on the graph are points of low speed. These correspond to places at the start of the race and at the "slowest" parts of the curves (turns)
- b) The horizontal parts of the graph correspond to times when the car was traveling at a constant speed.
- c) Possible description of one lap:
 - The car starts speeding up until it reaches a turn, then it begins to slow down, continues at a constant speed, then speeds up as it comes around the turn. This process continues as it goes around the turns.
 - Notice that the second "hump" is not as high as the other two; this is because the car has less distance to speed up before it comes to the next turn.

#10

- a) The room's heat is likely controlled by a thermostat, which turns the heat on and off at different thresholds.
- b) The "going up" part corresponds to times when the heat was on. The "going down" part corresponds to times when the heat was off and the room was cooling.
- c) The thermostat was likely turned down at night. Perhaps it was a "smart" thermostat with a night setback.

Answers Pg.160-162 #12

12. The graph shows the population of Arctic hares in an area that was once a mining community. With reforestation, other animals such as foxes and owls began moving into the area.



- When did the hare population reach its maximum number?
- When did the hare population reach its minimum number?
- Write a story that explains the behaviour of the graph.

#12

- The highest value on the graph, representing the maximum hare population, was reached around 1988.
- The hare population was the lowest at the beginning of the recorded period, and was at a relatively minimum number (between 1993 and 1999) around 1995.

c) Possible Answer:

- There were very few hares in 1983, when reforestation apparently began.
- Those that were there began to reproduce, slowly at first, until about 1984.
- The population increased steadily and rapidly from 1984 to 1986, when the growth rate slowed somewhat. Possibly more predators moved into the area at about that time since there were so many Arctic hares to feed them.
- The population increased until about 1988, when it leveled off, and remained fairly steady until 1992, when it began to decline slowly.
- The population declined sharply from 1994 to 1995, possibly due to a local disaster such as a forest fire or disease.
- The period from 1996 onward once again showed a steady increase; the disaster's effects were likely being reversed due to some natural process.

Warm-up # 18

Do the following questions:

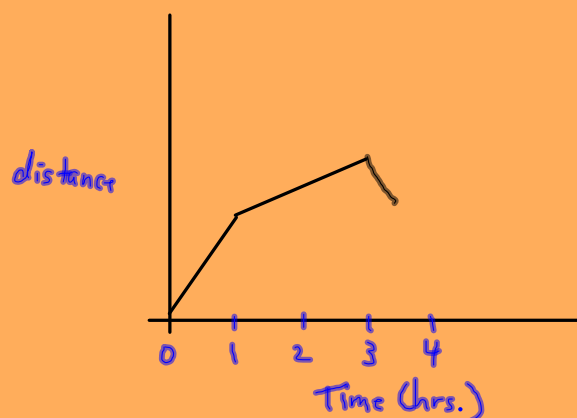
1) Page 208 #1a,b

1.a) slope: temp. change over time.
y-int: starting temp.

2) Page 208 #3a

b) highest temp.
lowest temp.

Draw both your x and y axis, label them, and then put a scale on your x-axis. Draw a sketch of the description given.



Broken-Line Graphs

- Match the graph with the situation.
- Work with a partner.
- Not all questions will be aparent right away.
- Sketch each situation as you go along.

Due at the end of the period.

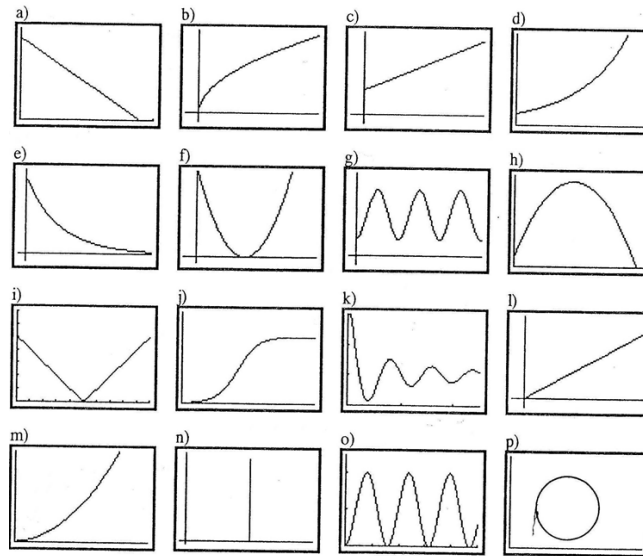
Match each of the given scenarios with the appropriate graph found on the other side of the sheet. You may wish to use a graph more than once.

Graph	Situation
<u>G</u>	1. The depth of the water in a port along the Bay of Fundy changes due to the tides. The depth of the water is the dependent variable and the time is the independent variable.
<u>H</u>	2. A pebble is shot vertically into the air using a sling shot. The height of the pebble above the ground is the dependent variable and time is the independent variable.
<u>L</u>	3. You are purchasing flour from the bulk section of the grocery store. The cost is the dependent variable and the weight of the flour purchased is the independent variable.
<u>K</u>	4. A carnival arrives in St. John's and Ryan decides to try bungie cord jumping for the first time. He is suspended in a basket by a crane 50 metres above the ground. Ryan's height above the ground in metres is the dependent variable and the time in seconds is the independent variable.
<u>A</u>	5. A pool is full of water. The water is being drained at a constant rate. The amount of water in the pool is the dependent variable and time is the independent variable.
<u>D</u>	6. A population of bacteria is initially 20 bacteria/mm ² however the population doubles every hour. The number of bacteria is the dependent variable and time is the independent variable.
<u>I</u>	7. An air hockey puck is shot at the opposite end of the table and it rebounds back. The distance between the puck and the opposite end of the table is the dependent variable and time is the independent variable.
<u>O</u>	8. Tom's girlfriend is on a swing and Tom is behind her pushing. The distance between Tom and his girlfriend is the dependent variable and the time is the independent variable.
<u>E</u>	9. Over 92 hours radon-222, a radioactive gas, decays to half its original weight. After another 92 hours that remaining radon-222 will decay to half of what it was. This process repeats itself every 92 hours. The amount of radon-222 is the dependent variable and the time is the independent variable.
<u>B</u>	10. Dave initially walks quickly away from a motion detector but gradually slows down as he continues to walk away. Dave's distance from the motion detector is the dependent variable and time is the independent variable.
<u>C</u>	11. A cylinder which is already half full of water is being filled at a constant rate. The depth of the water is the dependent variable and time is the independent variable.
<u>M</u>	12. A toy car starts at rest at the top of an inclined ramp. It is released and it accelerates down the ramp. The speed of the car is the dependent variable and the time is the independent variable.



- C 13. Ashley is a salesperson at a major electronic store. She receives a basic salary of \$200 plus a 2% commission on all her sales. Her weekly paycheck is the dependent variable and the amount she sells in one week is the independent variable.
- J 14. A few tomato seeds are planted in your garden. Over the next few months, the plant grows to maturity. The height of the plant is the dependent variable and the time is the independent variable.

Graphs :



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#1, 2, 3